Organic Diets Significantly Lower Children's Dietary Exposure to Organophosphorus Pesticides

Chensheng Lu,[1] Kathryn Toepel,[2] Rene Irish,[2] Richard A. Fenske,[2] Dana B. Barr,[3] and Roberto Bravo[3]

[1]Department of Environmental and Occupational Health, Rollins School of Public Health, Emory University, Atlanta, Georgia, USA; [2]Department of Environmental and Occupational Health Sciences, University of Washington, Seattle, Washington, USA; [3]National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, Georgia, USA

We used a novel study design to measure dietary organophosphorus pesticide exposure in a group of 23 elementary school-age children through urinary biomonitoring. We substituted most of children's conventional diets with organic food items for 5 consecutive days and collected two spot daily urine samples, first-morning and before-bedtime voids, throughout the 15-day study period. We found that the median urinary concentrations of the specific metabolites for malathion and chlorpyrifos decreased to the nondetect levels immediately after the introduction of organic diets and remained nondetectable until the conventional diets were reintroduced. The median concentrations for other organophosphorus pesticide metabolites were also lower in the organic diet consumption days; however, the detection of those metabolites was not frequent enough to show any statistical significance. In conclusion, we were able to demonstrate that an organic diet provides a dramatic and immediate protective effect against exposures to organophosphorus pesticides that are commonly used in agricultural production. We also concluded that these children were most likely exposed to these organophosphorus pesticides exclusively through their diet. To our knowledge, this is the first study to employ a longitudinal design with a dietary intervention to assess children's exposure to pesticides. It provides new and persuasive evidence of the effectiveness of this intervention. *Key words:* **children's pesticide exposure, chlorpyrifos, dietary pesticide exposure, malathion, organic diet, organophosphorus pesticides, urinary biomonitoring.** *Environ Health Perspect* **114:260–263 (2006). doi:10.1289/ehp.8418 available via** *http://dx.doi.org/* **[Online 1 September 2005]**

The National Research Council (NRC) report *Pesticides in the Diets of Infants and Children* (NRC 1993) concluded that dietary intake represents the major source of pesticide exposure for infants and children, and this exposure may account for the increased pesticide-related health risks in children compared with adults. However, direct quantitative assessment of dietary pesticide exposure in children to support this conclusion is no simple task: Several studies (Adgate et al. 2000; Fenske et al. 2002; Gordon et al. 1999; MacIntosh et al. 2001) have analyzed pesticides in representative samples of children's food, and only two have used biologic monitoring to specifically examine dietary exposures (Curl et al. 2003; MacIntosh et al. 2001). The paucity of exposure data renders the debate over pesticide-related health risks in children controversial (Flower et al. 2004; Garry 2004; Reynolds et al. 2005). Nevertheless, those studies have provided valuable information on dietary pesticide exposure among children and have prompted the needs to improve research methods in order to better assess children's exposure to pesticides through dietary intake.

The primary objective of this study is to use a novel study design to determine the contribution of daily dietary pesticide intake to the overall pesticide exposure in a group of elementary school-age children using a longitudinal approach. Here we report only results of urinary specific metabolites of organophosphorus (OP) pesticides, a group of insecticides known to cause neurologic effects in animals and humans, for the summer 2003 sampling period. Results of pyrethroid pesticides for the same summer sampling period, as well as results from other sampling periods, will be reported as soon as they become available.

Materials and Methods

Subject recruitment. Twenty-three children 3–11 years of age were recruited from local public elementary and Montessori schools in the suburban Seattle, Washington, area. A letter and a fact sheet describing the study were sent home with children. Families that were interested in participating contacted the research group directly by telephone or e-mail. Schools did not provide any assistance in recruiting subjects. A screening questionnaire was conducted over the telephone to confirm eligibility, which includes children exclusively consuming conventional diets and spending most of their time in one residency, with parents or caregivers willing to provide assistance in collecting specimen samples and other study-related information. Once a subject was enrolled, an in-house appointment was made to go over the study protocol and to obtain written consent from parents and older children, or oral assent from younger children. A questionnaire was also administered during this appointment that asked about household pesticide use to account for other sources of possible pesticide exposure. The University of Washington Human Subject Division approved the use of human subjects in this study.

Sampling period. Each child committed to a 15-consecutive-day sampling period, which consisted of three phases. Children consumed their conventional diets during phase 1 (days 1–3) and phase 3 (days 9–15). During phase 2 (days 4–8), organic food items were substituted for most of children's conventional diet, including fresh fruits and vegetables, juices, processed fruit or vegetables (e.g., salsa), and wheat- or corn-based items (e.g., pasta, cereal, popcorn, or chips) for 5 days. These food items are routinely reported to contain OP pesticides [U.S. Department of Agriculture (USDA) 2005]; we used data from the years 2000–2003. OP pesticides are not regularly detected in meats and dairy products, so these food items were not substituted.

All organic food items were purchased by the research staff from a single grocery store. Parents were asked to request organic foods for their children in phase 2 with the goal of exactly replacing the items the children would have normally eaten as part of their conventional diet. This method ensured that any detectable change in dietary pesticide exposure would be attributable to the organic food rather than a change in the diet. Each child's daily dietary consumption was recorded by a parent in a food diary throughout the study period. Organic food items, mostly juices and fresh vegetables and fruits, were purchased before and during the study period and analyzed by one of the laboratories contracted by

Address correspondence to C. Lu, 1518 Clifton Rd. NE, Room 226, Atlanta, GA 30322 USA. Telephone: (404) 727-2131. Fax: (404) 727-8744. E-mail: clu2@sph.emory.edu

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